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RUDOLF STEINER'S IMPULSE TO AGRICULTURE

EHRENFRIED E. PFEIFFER

In the years 1922-23, the problem of the increasing degeneration of seed stocks and of many cultivated plants brought a number of farmers, including Ernst Stegemann, to Rudolf Steiner for advice.

"What is to be done to stop the progressive ruin of seed quality and nutritional values?" It was in this form that the question was presented.

Among the observed facts to which reference was made, the following were perhaps among the most important: Alfalfa could, in earlier times, be grown and harvested for as long as 30 years in the same field, then only for 9 years, then for seven; at the time of the interview one was quite happy to maintain a stand for 4 to 5 years. Formerly a farmer could use his own rye, wheat, oats, barley, for many years as a seed stock. Now one always had to be using new varieties after short periods of time. There was an almost chaotic number of kinds, which, after a few years, would sink into limbo. Other questions, related to the increase of animal diseases, especially those connected with sterility and the growing incidence of hoof and mouth disease, had brought other people, such as Dr. J. Werr and Dr. E. Kolisko, and others working with the newly-developing Weleda drug company, to come to Dr. Steiner with these problems.

A third impetus was given by Count C. v. Keyserlingk, while questions having to do with the etheric aspect of plants, and the formative forces in general were presented by Dr. G. Wachsmuth and the author of this sketch. Answering such a query, about plant diseases, Dr. Steiner explained to the latter that actually it was not the plant itself that was, in the first place, diseased, "since it is formed from out of the healthy etheric". Rather, it was the environment, especially the soil. One would need to look for the cause of the so-called plant diseases in the condition of the soil and of the total environment. Indications with regard to the inner attitude of those who farm, and concerning the steps toward the development of new cultivated plants were given especially to Ernst Stegemann in the years that preceded the coming Bio-Dynamic Movement.

EDITORIAL BOARD OF BIO-DYNAMICS: ALICE HECKEL, EDITOR; FRED HECKEL, ASSISTANT EDITOR; PETER ESCHER, NEWS EDITOR.
Threefold Farm Spring Valley, N. Y.

In the year 1923 Dr. Steiner for the first time gave the procedures for making the bio-dynamic fertilizer preparations. And he did so without appending explanations—only as recipes: "If you will do this and that". Dr. Wachsmuth and the undersigned then made the first Preparation 500. It was buried in the garden of the Sonnenhof at Arlesheim, Switzerland.

Then, in the early summer of 1924 there came the memorable day when, in the presence of Dr. Steiner, Dr. Wegmann, Dr. Wachsmuth and the author, as well as a number of other collaborators, this first No. 500 was to be dug up again. It was a sunny afternoon, and we began to dig at the spot where we believed according to our memory—the memory supported by a number of landmarks—that we would find the preparation. The digging went on and on. The reader can conceive how we were sweating, not just from the exertion of the digging but because we were wasting Dr. Steiner's valuable time. He also became impatient and got ready to leave, with the remark that he had to be back in his studio at 5 P. M. At this moment the spade struck the first cowhorn. Dr. Steiner turned back and asked for a bucket of water and showed, then, how the content of the horn should be sprinkled into the water and stirred. The walking stick of the undersigned was the handiest available, and so it was used for the stirring. Dr. Steiner stressed above all energetic stirring, the formation of whirlpools, and the quick reversals of direction which reveal the whirlpool-forming action of this energetic stirring. Nothing was said on the subject of manual stirring or of stirring with a bundle of birch twigs. There followed some brief advice as to how the stirred preparation was to be sprayed out and (illustrated by a motion of his hands) for how big an area the quantity at hand was to be used. And with that there came to an end the memorable event that stood at the birth-hour of a world-embracing agricultural movement.

What struck the undersigned and still gives him much food for thought, is this development of things from one step to the next; from which one can see how objectively Dr. Steiner worked. He never proceeded from a previously-held, abstract aim of teaching, but out of the given facts at hand.

Now many years previously there had been made known through Dr. Noll various suggestions for the growing of medicinal herbs with strengthened effects of metallic substances or of silica. Dr. Steiner said personally to the author that this

material was valid only for curative plants, that one should under no circumstances use the metallic additions with the fertilizer preparations used for food plants. He pointed to the fundamental difference between curative and nutritive plants, which extends so far that a plant grown for its medicinal values could lose its effectiveness if it were heavily fertilized like a food plant. On the other hand, the use of the metals on food plants would even have the effect of injuring health. This, as we grasped it, referred in particular to the application of metallic seed disinfectants and of pesticides (copper, mercury, lead, arsenic), as well as certain stone meal preparations.

In this time Count Keyserlingk was engaged in inducing Dr. Steiner to give an agricultural course. Dr. Steiner was heavily overloaded with work, travelling, lecturing, and postponed the decision from week to week. Count Keyserlingk sent his nephew, Adelbert v. Keyserlingk to Dornach, and this young man explained that he would simply sit on Dr. Steiner's doorstep and not go away until he had his agreement to presenting a course. This assurance was then given.

The Agricultural Course was held from June 7th to June 16th, 1924 in the hospitable home of the Count and Countess Keyserlingk. Associated with it were also a number of discussions and anthroposophical lectures in Breslau, among which was the noted "Address to Youth". The undersigned did not have the privilege of taking part in the course, since Dr. Steiner had requested that he help care for a severely ill friend.

"I will write you what goes on in the Course", he said by way of consolation. The over-load of work resulted in the letter never being written, which was well understood although regretted. The general situation, however, was discussed with Dr. Steiner after his return.

To the question as to whether one should begin with setting up experiments by way of introducing the new method, Dr. Steiner answered:

"The most important thing now is that the blessings of the Preparations be carried to as large areas of land as possible, over the whole earth, for the healing of the earth and in order to improve the nutriment value of the field crops as widely as this can be done. That should be the aim. The experiments could then still be made later." Dr. Steiner apparently thought that the suggested ways of working ought to be given immediate practical application.

It is on this background that one must see the whole Agricultural Course: that here guidance was given for understanding and making practical use of forces which again lead into the plant world the spiritual forces that are also often called the cosmic forces.

In the course of this discussion of the measures now to be put into practice, it was also stated that the effects of the preparations and of the method "are for all, for all farmers", that is, not the privileged possession of a small, chosen group. This is all the more to be stressed since the only ones admitted to the Agricultural Course were such farmers, gardeners and natural scientists as had on the one side a background in the actualities of their work and on the other side a spiritual-scientific Anthroposophical background. The latter is necessary in order to understand and correctly evaluate what Rudolf Steiner explains; the Bio-Dynamic Method, however, can be employed by every farmer. This must be stressed, since many, later, got the idea that one could not work bio-dynamically if one were not an Anthroposophist. That on the other hand knowledge of the bio-dynamic method gradually leads the one who uses it to another world picture, that he to begin with learns particularly to judge the biological (i.e., life) processes and inter-connections in a different way than the materialistic, chemically inclined farmer, is of course something obvious. So too, he will bring to the dynamic (i.e. play of forces) in nature a greater degree of interest and of conscious awareness. One must learn to understand that there is a difference between mere application of the method and creative collaboration. A working together, in the development of practical applications, with the spiritual-cultural center, the Natural-Scientific Section at the Goetheanum, in Dornach, Switzerland, was especially advised. From there the spiritually fructifying, creative element was to go out, while the others brought to it both the questions and the practical carrying out of the principles.

The name Bio-Dynamic Method of Agriculture was not given by Rudolf Steiner but arose from the circle of those who at the start concerned themselves with the practical application of this new direction of thought. In the Agricultural Course (in which about 60 persons took part), Rudolf Steiner had presented the basic, new directions of thought concerning the connections of the earth, of the soil, with the formative forces of the etheric, the astral and the ego-activity in Nature. He had especially shown how the health of the soil and of the plant and animal

world depends on nature being again brought into connection with the cosmic, creative and formative forces.

To the consciousness of these connections he added certain practical measures (in the so-called fertilizer preparations). "The point now is", he said on one occasion to the author of this paper, "to carry this out in practical application, to 'translate' it."

How close to Rudolf Steiner's heart lay the idea of the collaboration of the School of Spiritual Science with practical life was something that came to expression in a conversation in another connection. At that time Dr. Steiner expressed the idea that a teacher at this school ought only to work there a certain number of years (he mentioned three) and then should work in a practical-life field somewhere else, and thus, through constant alternation, the connection with real life and its demands and requirements could never be lost.

The circle of those who became inspired by the agricultural course and joined in work at the task from the side of practical farming as well as of science, was in a state of constant growth. One need only mention such names as those of Guenther Wachsmuth, Count Keyserlingk, Ernst Stegemann, Erhard Bartsch, Franz Dreidax, Immanuel Voegele, M. K. Schwarz, Nikolaus Remer, Franz Rulni, Ernst Jakobi, Otto Eckstein, Hans Heinze and many others who joined the group as time went on. Also there was Dr. Werr, as the first veterinary. Out of the working together of those engaged in its practical application, with the Natural Science Section at the Goetheanum there arose, then, the bio-dynamic movement. It soon reached out to Austria, Switzerland, Italy, England, France, the Scandinavian Countries, over to the U. S. A., and today it has collaborators in all parts of the world.

At the time of the Agricultural Course the bio-dynamic direction of thought, and agricultural chemistry, stood opposed. The latter is essentially based on the views of J. v. Liebig, and it sought to find in explaining the taking up of substance by the plant from the soil, the sole explanation of the so-called nutritive requirements of the plants. Out of this arose the one-sided chemical fertilizer teaching of the Nitrogen-Phosphate-Potassium-Lime requirements of the cultivated plants. This fertilizer teaching still rules the orthodox, scientifically orientated agriculture of today. But this teaching is not even completely just to J. v. Liebig. He himself had expressed doubts that the exact application of the NPK teaching is suitable for all soils. De-

ficiency phenomena appeared in greater intensity on humus-poor soils than on soils rich in humus.

However, the following quotation shows, in a far deeper sense, that Liebig was not at all the hard-boiled materialist into which his followers turned him: "The inorganic forces always create only that which is inorganic. Through the effects of a higher force that works in the living body, a power of which the inorganic forces are the servants, there comes into being the organic, characteristically formed substance, which is different from crystal and endowed with vital characteristics". — "The cosmic conditions necessary for the plant being are warmth and sunlight."

"The higher force that works in the living body", "the necessary cosmic conditions"; the answer to this was given by Rudolf Steiner. He resolved the problem posed by Liebig, just through the fact that he did not remain standing at the purely substantial side of plant life but, with spiritual courage and with no preconceptions, took the next step.

An interesting situation then developed. The adherents of the purely material theory, who believed they had to reject the progressive thought indicated by Rudolf Steiner, are today forced by the facts of research in soil biology to go at least one step further. Things already recognized in 1924-1934 in the circles of those with bio-dynamic knowledge have today become common property. These include: the significance of the soil life, the soil being a living organism, the role of humus and the necessity of maintaining humus under all circumstances and, where it is lacking, of producing it. To the undeniable nutritive relationship between plant and soil there has today been added knowledge of the biological, organic laws. One can go so far as to say that the biological part of the bio-dynamic method has become common property. Indeed perhaps the mark has been overshot with it all. Despite the importance of the biological conditions of the ecological relationships and interweaving of the plant world, of questions of soil structure, the biological control of pests, the steps forward in the field of humus economy, all of this still gives no answer to the question of energy, or the source of force, i.e. the cosmic conditions required by the plant being. In a definite way the "biological" direction of thought has been taken up, although materialized. The dynamic side still waits for the understanding toward which the basic explanations of Rudolf Steiner have pointed the way.

Since 1924 a number of works have been published that

appear as an initial groping by science in this direction. We refer to the publications having to do with growth-regulating factors, the so-called growth-substances, enzymes, hormones, vitamins, trace elements and bio-catalysts. But these gropings always remain in the realm of substances. One has, indeed, come so far that effects of substances in dilutions of one to one million, even one to 100 million are no longer assigned to the realm of the unbelievable, the fantastic, to be met with skeptical laughter such as was encountered by the rules for application of the biodynamic fertilizer preparations. These, with a dilution of between one to ten and one to a hundred million are still quite conceivable—conceivable, that is, in line with the *present* stage of knowledge. In the knowledge of photo-synthesis, i.e. the building up of substance in the living plant cell, one has already broached the problem of the influence of energy (sun, light, warmth, the moon). This field of study deals with the transformation of cosmic sources of energy into chemically-substantially effective energy and states. One can read with interest in this connection the following, by W. R. Williams, Member of the Academy of Sciences of the USSR. They are excerpts from his "Principles of Agriculture," 1952:

"The task of agriculture is to transform the varying sun energy, the energy of the light, into the inner force of foodstuffs for human consumption. The light is the basic raw material of the agricultural industry. Light and warmth are the necessary conditions of plant life. Light is the raw material out of which the agricultural products are made and warmth is the power which drives this mechanism of the plant. The dynamic energy of the sun radiation is transformed by the green plant into the material form of organic substance. So our first concrete task is the unending creation of organic substance in order to store up the inner energy for human life."

"One can divide the four essential factors into two groups according to their origins: light and warmth as cosmic factors, water and plant nutriments as terrestrial factors. The first group stems from inter-planetary space . . ."

"The cosmic factors work directly on the plant while the terrestrial factors only work through an intermediary, through substance." The author of this work, which appeared in Russian, designates knowledge of the working together of the cosmic and terrestrial factors as the first objective of agricultural science, and knowledge of organic substance (humus) as the second. Thus it is stated in 1952.

In 1924 Rudolf Steiner pointed to the necessity of again consciously bringing the cosmic forces, both direct and indirect, into the growth processes, that is, to rescue knowledge of the being of the plant from its isolation in the substantial, purely terrestrial. Only thus would it be possible again to make effective the health-building and upbuilding forces that work against the degenerative processes. "By the middle of the century", he said in the course of his advice to the undersigned, "spiritual-scientific knowledge must have become life practice in order to prevent unspeakable injury to the health of nature and mankind".

The methods of research: first to demonstrate the formative forces, and on the whole to find something by which the formative forces could be tested and demonstrated. Suggestions for this were given, which could only later be realized in the Crystallization Method of the undersigned. Then to show the weak points of the materialistic concept and to refute the results of materialistic research by means of its own experimental methods, i.e., to use exact analytical methods in the realm of substance and develop them still further. The thought throughout was to work quantitatively, not just qualitatively. For instance, the author had, during his college studies, to see Dr. Steiner each semester and present his plan of studies, and was advised in detail by Dr. Steiner about the choice of subjects. It happened in this connection that Rudolf Steiner advised taking two, indeed three chemical laboratory courses,—analytical, physical and botanical—at the same time. To the objection that this would simply not be possible in terms of hours per day he said only, "Oh, you will be able to overcome that problem."

Always there was the suggestion of practical and laboratory work, *not* clever theory spinning.

In the course of the ten year period of work that arose out of this, these suggestions stood before the soul of the undersigned and induced him not only to work in the laboratory but also to apply the reality of the knowledge gained, in the management of agricultural enterprises. This was done not only in the bio-dynamic sense but also from the economic point of view. "Unless one works economically, that is, in a way that brings in profit, the whole thing simply doesn't go," was Dr. Steiner's instruction at the very beginning. The latter asked that in addition to the natural-scientific studies the undersigned also attend classes and lectures in political economy.

From these and many other suggestions it now became entirely clear what was to be done to introduce the bio-dynamic

method. There was the large circle of the practical farmers. It was for them to carry out the application of the method on the farms. The best conditions for the effectiveness of the preparations—humus-building instead of humus-destroying crop rotations—had to be developed. The basic points of view for animal and plant breeding evolved themselves. It took years until the "translation" of the basic ideas into practice was completed. All of this was tested by the hard experiences of daily life, until the complete picture was there—a teachable and learnable method in which every farmer can share to his advantage. Questions that had to be answered in practice included those of soil cultivation, crop successions, the treatment of manure and compost, turning the heaps at the right time, animal husbandry and breeding, the care of fruit trees, and many others.

Then followed the discussions with representatives of agricultural science. For this, it was necessary to accumulate facts, observed data from laboratory research and field tests. The technical and quantitative-chemical education asked of the undersigned came to use here. It is in this sphere, where perhaps the lacks or weaknesses of the chemical theory of soils and nutrition showed themselves most clearly, that one today—after more than 30 years—sees the possibility of building a bridge between the perception of cosmic forces and an exact science.

The first sign of a break-through in the stagnant body of opinion showed itself, perhaps, in the discoveries that grouped around the concept of trace elements. In 1924 Rudolf Steiner pointed to these fine amounts of matter that are distributed in the atmosphere or otherwise, mentioning especially that they contribute very much to the healthy development of the plant world. With this the question still remained open as to whether these fine amounts of matter were taken up through the roots out of the soil or out of the atmosphere by the leaves and other organs of the plant. At the beginning of this thirty-year period it was determined by spectrum analysis that almost all elements are present in the atmosphere in dilutions of from 10^{4} to 10^{5}. The question as to whether these trace elements could also be taken up out of the air was first settled affirmatively in connection with the Tillandsia usneoides (Spanish Moss). Today it is the general custom in California and Florida to bring zinc and other trace elements to the plant, not in the fertilizing, through the root, but by putting it on the leaves, since the leaves take up the fine substances very well, better indeed than do the roots.

It was discovered that one-sided mineral fertilizing impoverishes soils and plants with regard to trace elements. Perhaps the most important discovery was, that adding the trace elements to the fertilizer by no means signifies that the plants can always take them up. The presence or absence of zinc, in a ratio of one part to one hundred million determines whether an orange tree produces healthy fruit or not. One recalls that in the years from 1924 to 1930 people ridiculed the bio-dynamic preparations "because one certainly cannot influence the plant with high dilutions."

We referred to zinc in this connection because on the one hand this trace element is so exceptionally essential for the health of a number of plants, and also for their yield—just exactly in the highest dilutions—and on the other hand it is especially accumulated in fungus growths. A remark of Rudolf Steiner's points to an interesting inter-relationship, which can really only be properly understood in the light of the newest research of the last decade. On page 107 of the Agricultural Course, German edition (p. 78 Eng. transl.) we read: "Harmful parasites are closely connected with fungi . . . In this way there arise plant diseases and other greater ills in plants . . . One should see to it that the moist meadows are well-planted with such (fungus) growths. We then make the following remarkable discovery, that if a meadow, not necessarily very large, but rich in fungi (e.g. mushrooms) is situated near cultivated land then the fungi, because of their kinship with bacteria and other parasites, will keep these creatures away from the farming-land. . . . Thus in addition to the other methods I have advocated for combating plant pests there is also the possibility of keeping these tiny creatures, these vermin away from cultivated land by converting land in its vicinity into meadows."

Among the fungi and fungus-like organisms belong also the so-called fungi imperfecti and a botanically intermediate member, the ray fungus or Actinomycetes and Streptomycetes from which in recent years the anti-biotic remedies are being extracted. These organisms, so the undersigned has found, have a quite special share in humus formation and the rotting processes, and are accumulated to a high degree in the bio-dynamic fertilizer preparations. In these preparations there also takes place an accumulation of a number of the most important trace elements, such as molybdenum, cobalt, zinc and others whose value is today recognized on the basis of experiment.

With respect to soils there now arose a unique situation. Analysis in terms of available plant nutrients showed that these figures vary in one and the same soil at different times of the year. Seasonal and even daily variations revealed themselves. The differences to be found in these variations are often larger within the same test area than the differences between neighboring fields, a good and a poor soil. But seasonal and daily variations are conditioned by the position of the earth within the planetary system, i.e. are of cosmic origin. In fact one finds times of the day and times of the year which variously influence the solubility and the availability of the nutritive substances. In the physiology of plants and that of animals (glandular secretions, hormones) one finds numerous phenomena that are subject to such influences. The leaf of the Bryophyllum contains oxalic acid, the concentration of which follows the time of day almost like the hand of a clock. Although here and in many other cases the substantial nutritive basis is the same—plants of the same species can, under the influence of different light rhythms and cycles, have an entirely different intake and loss of substances. Joachim Schultz, a regrettably too-early deceased research scientist at the Goetheanum, had begun to test experimentally an important statement of Rudolf Steiner's, namely that the effects of the light in the morning and evening hours influence plant growth differently (beneficially) than do those of the noon and midnight hours (hinderingly).

Observing Schultz's experiments, the author of these lines was struck by the fact that plants grown on the same nutritive solution showed completely different synthesis of substance, nitrogen for example, in accordance with the light rhythms to which they are exposed. Those exposed in the morning and evening hours showed a rich growth, benefited by nitrogen effects. Those under mid-day light only, were stunted and showed deficiency symptoms. With these tests the way is now experimentally prepared for demonstrating that the so-called "cosmic" effect of the light, the warmth, of the sun especially but also of other sources of light, controls happenings in the field of substance. They regulate the course of substantial changes. When and in what direction these take place, and to what extent the total growth, the form of the plant is influenced thereby, depends on the cosmic constellation and source of energy. The latest research in the field of photosynthesis, too is of a sort to open the eyes of the materialistic circle to such occurrences. It would seem to us that Rudolf Steiner was also

the forerunner here, the one who prepared the way for a new direction in research. It is not possible within the bounds of this essay to tell of all the already-known phenomena, for these would more than fill a volume. It is no longer possible to dismiss the influence of the cosmic forces with the word "superstition". One becomes unable to do that as soon as one takes into consideration the physiological and biochemical dependence upon the cosmic forces of the metabolic function, the soil life, the sap flow in the plant, and especially also the processes that take place in the sphere of the plant root.

There was an older way of looking at nature, based in part on Mystery tradition, in part on instinctive clairvoyance, and extending from the time of Aristotle and his pupil Theophrastus the botanist, to the period of Albertus Magnus and the late Medieval teaching of "signatures". In that approach to nature, relationships were spoken of between the individual plant species and specific cosmic constellations. These constellations are the creative impulses under whose influence the species differentiated themselves, and different forms of being arose. If one considers that cosmic rhythms have such a significant influence on the physiology of metabolism, on the function of the glands, of the lymph stream and turgor, then it is only a small step to the next perception—the conscious and scientific investigation that is coming—experimental study of the effects of the creative constellations. Numerous collaborators of Rudolf Steiner have already demonstrated the controlling effect of the formative forces, by means of experiments (capillary method on filter paper, L. Kolisko), or in plant and crystallization tests. (Pfeiffer, Krueger, Bessenich, Selawry among others).

A special task developed out of suggestions of Rudolf Steiner for plant breeding. The investigations in this connection were carried out by the author of this paper and other collaborators (Immanuel Voegele, Erika Riese, Martha Kuenzel, Martin Schmidt), partly in collaboration, partly independently. Starting from the basic idea of the cosmic, creative constellations, one can realize that in every species or sub-species the original impulse slowly ebbs away and becomes lost. This original impulse is inherited in the plant as formative force, being transmitted by certain organs (chromosomes for example). One-sided fertilizer material gradually drives out the after effects of the original forces, so that the plant becomes "weaker". The seed quality degenerates. This was the problem that was first brought to

Rudolf Steiner and which stimulated the creation of the bio-dynamic method.

The task was to give the plant, as a system of forces under the influence of cosmic effects, back again to the whole of Nature. Rudolf Steiner indicated that a number of the "worn out" plants, i.e. those that had become alienated from their origin, are degenerating at such a rate that by the end of the Twentieth Century one will no longer be able to rely on them for field culture. Wheat and potatoes, among others, were mentioned, but other crops such as oats, barley, and alfalfa, too, come into this category. The ways were outlined by which, from wild, still unexhausted relatives of the cultivated plants, new varieties with viable seeds can be grown. These tasks have been begun with good results. Already today there are new varieties of wheat in existence. Martin Schmidt has done as yet unpublished but significant work to show the rhythm of seed arrangement in the grain ear, and especially to demonstrate the difference between a food plant and a seed plant. According to Rudolf Steiner this basic difference in characteristics arises in accordance with whether the sowing of the seed is done nearer to the winter or the summer season. In the development of the proteins, amino acids, phosphorus lipoids, enzyme systems, etc. the bio-chemist will one day also be able to follow these differentiations in terms of substance, with the methods of modern chromatography.

The degeneration of wheat has today become a fact. Even on good soils, the protein content is going down (from 13% to 8% in the case of red wheat in a number of regions of the U.S.A. during the last 30 years). Whoever grows potatoes knows how difficult it is still to raise a healthy potato not attacked by insects and viruses—not to mention the question of potatoes *with flavor*. Bio-dynamically raised wheat has maintained itself on the high protein level. The very promising work in potato breeding has, regrettably, been interrupted by war and other disturbances.

Seen from the dynamic point of view, the problem of the pests is one of the most interesting and instructive. A biological balance is disturbed, degeneration comes as a consequence. There is an onset of pests and diseases. Nature herself liquidates that which no longer has the capacity for life. So pests are actually a warning from Nature that the original forces are being lost and that one has been sinning against a state of balance. For this warning, American agriculture today is paying,

according to official figures, five billion dollars annually in crop losses, plus an additional seven hundred and fifty million for pesticides. That one does not achieve one's goals with insect poisons, and is, despite the poisoning, producing new and resistant pests, is something that is beginning to enter people's consciousness. For example, it is being established by the most advanced scientists (Albrecht of Missouri) that by one-sided fertilizing the balance of protein and carbohydrate in the plant cell has been disturbed, to the detriment of the protein and the protective layers on the outside of the leaves. He has shown that as a consequence the plants become "tastier" to the pests. Gaining the insight that insect poisons only preserve what is beginning to become a "corpse of Nature" but cannot hold back the general dying off, is a bitter experience. Already leading entomologists are making their voices heard, opposing chemical attempts to control pests and the disturbances of health connected with this approach, and are advising biological controls. Yet biological control, according to the instructions given, for example, by research stations in the U. S. A., is only then possible when one applies no poisons and tries to re-establish the natural balance. That health and resistance to diseases and pests is a function of the biological balance, including the cosmic factors, had already been explained by Rudolf Steiner in statements in the Agricultural Course. Here too it is plain to what an extent this spiritual-scientific way of thought, based on Goethe, was ahead of its time.

The author is very conscious of the fact that this paper only touches on a fraction of the total complex of questions that was opened up by Rudolf Steiner's new Method of Agriculture. He also realizes that every other collaborator in the great agricultural work would perhaps write quite differently, and of different things. So the reader is asked to regard these lines as they were meant: a view from one single window, in a house in which there are many rooms.

ANNOUNCEMENT

The editors of this quarterly take pleasure in announcing the marriage of Miss Evelyn Speiden and Mr. Richard B. Gregg, on April 22nd at 4 P. M. The simple ceremony was held at the Christian Community House in New York City.

SUMMER CONFERENCE PLANS

The annual Summer Conference of the Bio-Dynamic Farming and Gardening Association, Inc., will take place this year over the week-end of July 27th-29th. As in previous summers, it will be held at Threefold Farm, Spring Valley, N. Y.

The general theme of the sessions will have to do with the plant as a link between the soil of the earth and the food we eat. Dr. Pfeiffer plans to speak on "A New Concept of Living Matter" and also to give a lecture on "Proteins, Enzymes and Growth Promoters". Miss Speiden will lecture on "The Origin of Cultivated Plants".

William Coda Martin, M. D., of New York City, an expert in the field of nutrition, Dr. Ernst Lehrs, author of "Man or Matter", Miss Erica Sabarth and Mr. Peter Escher are among the other scheduled speakers. Day to day farm and garden problems will be dealt with in the course of the program, and there will be periods set aside for general discussions.

Because of space limitations, reservations should be made in advance, addressing Mrs. Richard Kroth, Threefold Farm, Spring Valley, N. Y.

INDEX READY

A complete index of all the important material that has appeared in Bio-Dynamics since its founding in 1941, and running through 1955, is now available. Printed in our regular type for legibility and easy reference, the booklet may be ordered, at 25c a copy, from the B. D. Association office at R. D. 1, Chester, New York. It covers the material in issues 1 through 38, and it pages are of the same size as the Quarterly.

At the end of this year an annual index will be included in the magazine itself, and this will be the practice in future.

THE IDEAL SOIL

EHRENFRIED E. PFEIFFER

What makes the ideal, fertile soil?

Many have thought it is fertilizer that makes crops grow. They came to this idea because the nutrients (mineral or other) are what is available to plant roots. Some look upon the soil as only a carrier of nutrients, natural or added. This idea becomes increasingly reasonable if one considers hydroponics, the use of water cultures to which all major and trace minerals have been added. One can top the result of even a well-balanced mineral solution in these cultures, by adding humus to the solution. Humus in soil is looked upon as a major, indeed a decisive, factor. A soil definitely remains fertile only if and as long as humus is present, the more of it the better.

Recently, in our soil testing and research laboratory we came across two samples of soils, one was from Holland, the other from Illinois. We found that their content as regards the major, available minerals was about the same: potash, phosphates, nitrates — there was a slight difference in lime and organic matter, the Dutch soil being a few points better.

But the differences were not enough to explain why the Dutch soil had yielded 135 bushels of oats per acre last year (unbelievable, but well confirmed by witnesses), while the other soil had produced a very poor yield. The latter farmer explained that in spite of applying lots of manure, compost and other necessary fertilization he had difficulties in obtaining adequate yields. Both samples were taken in wintertime, both were equally moist. One can give the Dutch sample the benefit of better climatic, better weather conditions. But then, this soil had received its most recent gift of manure 5 years ago, and had grown good yields throughout the observation period of 20 years.

We had to go deeper (literally) to explain the difference, and we investigated the subsoil in each case. The Dutch sample of topsoil was from zero to 10″ in depth. A sample of the subsoil under it, from a depth of 10″ to 20″ was analyzed. It showed almost the same available mineral findings as the topsoil, but the organic matter of the subsoil was 1.5% while that of the topsoil was 2.5%. The other, poorly-yielding soil had a topsoil of 10″ in depth, and was sitting on a hardpan. Deep-growing roots were able to profit from the subsoil in the Dutch sample, while nothing could grow deep in the Illinois sample. The Dutch

soil showed an ideal humus formation to a great depth. Physically there was an ideal, crumbly structure, with good aeration and soil life, and no hardpan, to a depth of 20″, while in the poor soil — of quite similar findings with respect to available minerals — there was no depth, due to the various layers of hardpan.

We have investigated many soil profiles recently, and found that most roots do not penetrate hardpan, and stop growing, even begin to move away, horizontally instead of downward, in such cases. These hardpans become an especial handicap if the soil is acid and produces strata of acid humus compacted in the deeper layers.

It came to our mind that in 1933 we had seen an interesting experimental field at the Missouri Experimental Station. It had been kept in several plots for decades, in the following manner: one group of plots was left as it had been originally, as virgin prairie, not troubled by man. This area had a deep soil and showed no structural change, no hardpan, was crumbly all the way through. It was deep. The good Dutch soil with the top yield resembled it.

Other plots were treated in various ways — corn grown right after corn, a corn-wheat, corn-wheat rotation, i.e. one-sided rotation and cultivation; others had a sound crop rotation, etc. We were shown that the more one-sided the rotation and cultivation was, the more the virgin, ideal structure had vanished and deficiency symptoms as well as hardpan and crust showed up.

From these comparisons, we learn the important lesson that the ideal soil is deep and has no hardpan and other structural disadvantages. It is well aerated and the humus formation as well as microlife can go to great depths. It should be noted in this connection that the Dutch sample came from a field under cultivation for several hundred years, but with sound management and proper rotations.

It is the kind of cultivation, plowing, etc., that creates a hardpan and compacting process which transforms a good soil into a poor one. This includes not only mechanical errors but also mistakes in fertilizing. The poor soil is poor because it does not offer enough area for root growth; it remains superficial, shallow. Wherever man has caused hardpans, he has ruined the original capacity of his soil. Any plowsole which influences roots to grow away from it, or to stop penetrating the soil entirely, is a detriment. No fertilizer, not even organic matter, can

help when the soil becomes shallow. We say "becomes shallow" because many a soil had the capacity to remain deep.

The ideal soil therefore is one which is not ruined by cultivation and fertilizer. A good farmer is one who is able to maintain or even increase the depth of his soil. The more a soil has been ruined structurally, the more it *seems* necessary to correct with fertilizer, without ever getting at the bottom of the trouble, that is without ever correcting the original sin against fertility. Farmers spend a lot of money and effort but actually render the best fertilization program ineffective as long as they don't know how to grow their soils deeper. For that reason we thought it worthwhile to tell of the two samples which were chemically almost alike, in fact according to the standards of soil testing both perfectly alright, but which varied so widely in their production. The one standing way at top of international yields, the other yielding poorly.

WINTER ENDIVE

Dyrham Park Gardens, June 4, 1836

On a NEW AND ECONOMICAL WAY OF PRESERVING ENDIVE THROUGH THE WINTER.

As the season for endive is fast advancing, I send you the following account of a mode of preserving that plant, which I tried last year through necessity, on account of our new pits having been built too late in the autumn to receive the endive plants for forcing in due time. I covered about one thousand full grown green curled endive plants over with pans similar to those generally used for strawberries in the forcing season; and, knowing that the pans would neither keep out the frost from the plants, nor the rains from the border, without some additional protection, it struck me that leaves would be better than any other covering, on account of their absorbing the moisture. I accordingly covered the whole border with tree leaves to the thickness of 9 inches after getting the border as dry as the autumn would allow. Nothing more was done. The green curled endive, so treated, was much better than I have ever had it in frames; and two heads went nearly as far as four, on account of every leaf being well blanched. I am quite certain, that those gardeners who have the command of fine light ground will have no occasion to use frames at all. The ground here is nearly as stiff as any I have ever seen; and it is more liable to damp. I am also certain, from the nature of leaves, that, where people cannot command pans, by taking the best dry leaves, the plants would keep nearly as well without as with pans.*

*The Gardener's Magazine, July 1836.

HERBAL MANUAL FOR FARM AND STABLE, by J. de Bairacli-Levy. Published by Faber & Faber Ltd., London.

Many people who keep one or two milk goats for the family milk supply have had the experience of calling the veterinarian only to find that he would rather not treat a milk goat. Perhaps he did not have much training in the treatment of sheep and goats in his education. Maybe he shares the cattleman's common prejudice against these animals. During World War II we found we were in an even worse predicament: there was no veterinarian within miles to call if we had needed him.

For all of these reasons we were very happy to learn that Juliette de Bairacli Levy was writing a HERBAL HANDBOOK FOR FARM AND STABLE.

We had a milk goat a few years ago who seemed to be suffering from hoof rot. But even after we had improved her ailing hooves with chervil, chamomile and lemon balm, as suggested in the Companion Plants leaflet issued by the B. D. Association, she continued to fail in health. Not knowing where else to turn, we wrote to the Information Service of the Soil Association (of England) of which we are members, and received a most gracious reply from Mrs. Levy, outlining the possibilities and suggesting some herbs to use.

Her book is written with equal care, divided into a section which deals with diseases, symptoms and treatments for each animal. She deals with "Herbal Treatments for Sheep, Goats, Cows, Horses, Poultry and Sheep-Dogs". In addition to treatments for specific symptoms, she also makes many suggestions of ways to improve the animal's general health — to prevent its getting the disease symptoms at all.

Whether one uses the medical information or not, the book stimulates one to be alert to the presence of many heretofore unknown plants. There is one chapter at the beginning describing the general methods used with herbs: how to gather and dry them, and how to make infusions, decoctions, etc., from the different parts. This information is useful for general knowledge on the subject of herbs.

The next section is a Materia Medica Botanica which gives the botanical description, the medical use and the dose for each animal. Since the plants she describes are native to England, we have had to study the book in conjunction with several American botany books to be sure we know what plants she recommends. Many of her plants grow in other parts of the United

States but do not grow in Missouri. As many as we have found, we have tried to grow near enough so that we could gather them in case of need. For instance last spring we transplanted clumps of elder roots, which we are hoping to encourage as an ornamental shrub to grow around the homestead. She says of it, "This is one of the most important of all herbs: it possesses the strange powers of being beneficial in the cure of almost all the common ailments of man and animal." We tried it in a decoction with dock leaves for one of our goats which had a condition resembling cow-pox on her udder. It was possible to actually see the slow process of improvement. We also fed garlic internally, according to her recommendation.

There is a very tiny blue flower which we had often noticed springing up in the lawn in early spring. No one locally knew its name, and no one knew that it had any use. We were pleased to learn that it is speedwell. The book says "The leaves are eaten by all animals, for their tonic properties; they impart a good flavour to the milk of cows and goats. The plant is remarkably medicinal, out of keeping with its frail form. It is an excellent mucous expellant, and for that reason is much employed as a pectoral and anti-catarrhal. It is used in dysentery, jaundice, skin and eye ailments." The eagerness with which our milk goats devoured the plant when we fed it to them, proved they must esteem it as highly as the author.

If one follows "modern" methods of feeding for baby chicks, one cannot avoid chick feed with antibiotics and even drinking water with some chemical sterilizing agent in it. Some of us are "old-fashioned" enough to want to know what was used before these modern chemicals were discovered. The HERBAL HANDBOOK gives many suggestions for diet for baby chicks, hints about hatching eggs under a hen, herbs and foods to keep the chicks in good health, and treatment for illness if they should not be well. One of her best suggestions, which we use in every emergency, is in the section for baby chicks but it has worked equally well for goats, sheep, chickens, our dog when he was struck by an automobile and even for people: "In cases of severe exhaustion give drops of warmed honey . . . This is applicable for all *poultry* treatment; honey is an immediate restorative."

Garlic seems to be almost as universally applicable "for the treatment of all ailments in which the cleansing of the bloodstream and expulsion of mucous accumulations is required. It is supreme in the cure of all infectious ailments of the bloodstream, lung and digestive areas. American scientists discovered

that garlic contains a substance — crotonaldehyde — which is excellent for diseases of the nose, throat and intestine. It is also of especial use as a febrifuge and vermifuge. Externally, for the disinfecting and healing of all types of sores and wounds, also parasitical infections . . . The supreme immunizer of stock against all infectious diseases."

We recommend the book for two purposes. For general information and interest, it is a never failing source of wonder and fascination. But for actual, practical use, it is without exception our favorite book — and so far, everyone who has borrowed it from us has ended up with buying a copy!

HELEN PHILBRICK

(Available on order through the British Book Center, Inc., 122 E. 55th St., New York, N. Y. Cost $4 — ten percent discount to readers of Bio-Dynamics, no charge for postage if order is prepaid.)

LET'S EAT RIGHT TO KEEP FIT. By Adelle Davis, author of *Let's Cook it Right* and *Let's Have Healthy Children.* Harcourt, Brace & Co., New York, 1954. $3.00

This book is written with the specific needs of the present time in mind. Our foods have decreased alarmingly in value through methods of agriculture, transportation, storage, processing, familiar to readers of *Bio-Dynamics.* The author, who pays tribute to Pfeiffer, Bromfield, Howard and others who have worked to improve agricultural practice, is aware of the difficulties we have in getting the supposed food elements from the products the market offers us. In former years, "the paupers were better off," in spite of the greatly increased varieties of food available at all seasons in city markets. In former years a knowledge of nutrition was not so essential as today, and even now it is apt to be considered a professional requirement. People face the double hazard of their own ignorance and scarcity of wholesome foods.

To give the reader a workable guide to food selection—not menus or diets—but a fundamental view of our food requirements, is the main concern of the book. The material is here for working out a food program based on individual needs. There are also very helpful suggestions on how to recognize deficiencies in each class of food (most of which can be discovered by looking in a mirror), and what foods and food supplements will correct them. The latter she advises with reluctance but says that present conditions make them necessary in most cases of malnutrition.

The author, who holds a degree of Master of Science from the University of Southern California Medical School and is a consultant in nutrition, is deeply versed in the scientific background of her subject and does not offer conclusions without giving a full explanation. A great deal of material which would ordinarily be found in technical works has been translated into a readable book for the layman, using an informal and conversational style which will make things easier for many readers but may prove irritating to some. Let no one ignore the fact that there is sound substance here, however. A spirit of idealism, a desire to help people help themselves pervades the whole book, and particularly a wish to inspire a sense of responsibility on the part of all of us in regard to improving the national health.

HELEN COMSTOCK SIBER

CRICKETS IN GREENHOUSES

Having had a great many strawberries as well as pineapples destroyed by crickets, I should be greatly obliged to you, or any of your readers, if you could inform me of the best method of destroying them. Kent, May 23, 1836.

A device that I have known to be used for capturing crickets in a house, and which was effective is putting portions of the crumb of bread into a basin, with a portion of water that did not fill the basin by a good deal: the crickets got into the basin and were drowned.*

Note: We have often observed that the black spiders in our greenhouse are very efficient in capturing and killing crickets.

(H. L. P.)

*The Gardener's Magazine, July 1836.

POSSIBLE CANCER HAZARD PRESENTED BY FEEDING DIETHYLSTILBESTROL TO CATTLE

Presented at Symposium on Medicated Feeds, Food and Drug Administration, Washington, D. C., January 24, 1956.

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Reports such as the following significant paper, of interest not only to meat producers but to all consumers, all too frequently are buried in official archives and never heard of again. The editors of Bio-Dynamics are glad of the opportunity to give this well-documented statement a wider degree of circulation. One of the contributors, Dr. Martin, is already known to our readers.

Introduction of the powerful drug, diethylstilbestrol, into the nation's food supply prompts consideration of the actions of this compound. It is known to induce cancer[1], [2]. It has also been found to stimulate weight gain. For the latter reason, there has developed a practice of administering this drug to poultry and beef cattle in the United States[3].

It has been estimated that more than 30,000,000 chickens per year are implanted with pellets of diethylstilbestrol, and that approximately half of the feedlot cattle in the country are now given feeds to which this drug has been added. In poultry, the pellets are intended to be inserted at the base of the skull on the supposition that this part will be discarded and not eaten. But among nine lots of poultry coming into the New York market and examined by inspectors of the Food and Drug Administration, about 35% of the birds were stated to contain such pellets in the neck. Similar findings from subsequent investigations, and the residual diethylstilbestrol was reported as 3 to 24 milligrams per bird[4]. It has been claimed that no appreciable quantities of diethylstilbestrol can be demonstrated in the tissues of cattle fed this drug[3], but this claim may convey a false sense of security for reasons subsequently given in this presentation.

Diethylstilbestrol can be made ineffective under conditions involving exposure to a temperature of 428 degrees Fahrenheit for several hours[5]. The temperature recommended for roasting

chickens is 350 degrees Fahrenheit. Temperatures of only 140 to 180 degrees are found in the interior of roasts of beef[6]. From these figures, it is apparent that diethylstilbestrol would not be destroyed by cooking, and could be conveyed to consumers of meat containing it.

It thus seems pertinent to review the effects that this compound can exert. Administration of estrogens, among which diethylstilbestrol is one of the most potent, has led to a wide range of pathological changes in human beings and in animals. In mice, rats or guinea pigs, estrogens can induce polyps, fibroids and cancers of the uterus, cancers of the cervix, cancers of the breast, hyperplasia of prostatic stroma and of endometrium, tumors of the testicle and hypophysis, and leukemias[2].

In the experience of one of us (R.I.), uterine tumors have frequently been found in guinea pigs given as little as 1.5 milligrams of diethylstilbestrol or other estrogens in subcutaneously implanted pellets[7,8]. Indeed, tumors have resulted in guinea pigs exposed to as little as 8 micrograms (eight thousandths of one milligram) of diethylstilbestrol per day[7]. Lower dosage levels have not yet been tested in guinea pigs, but in current experiments a pellet removed from a guinea pig one year after implantation has been found to retain sufficient activity to induce a tumor upon reimplantation into another animal.

Investigators at the National Cancer Institute have reported that cancers of the breast can be induced in mice by as little as 0.07 microgram of diethylstilbestrol per day[9]. This dosage sufficed to induce breast cancer in about 50% of male mice, who do not develop such tumors in absence of exposure to an estrogen. A total dose of 30 micrograms was effective in these experiments, in which the drug was administered in a subcutaneously implanted pellet. These and other investigators found that diethylstilbestrol also induced tumors readily when given to mice by mouth.

Normal mice excrete between 0.05 and 0.1 microgram of estrogen per day[10]. So delicate is the physiological balance that exposure to an approximately equal additional amount (0.07 microgram) of estrogen (diethylstilbestrol) per day suffices to induce cancer, as mentioned above.

From the above findings, it is obvious that the cancer-producing dose of this drug approaches the infinitesimal. Claims that no appreciable quantities of it can be demonstrated in tissues of cattle to which it has been fed must therefore be carefully scrutinized as to the sensitivity and accuracy of the test

methods. An equally cogent consideration is that the fundamental mechanism of cancer induction by diethylstilbestrol is not understood. Many tumors are known to be caused by viruses[2]. In mice, cancer of the breast has been traced to a virus. But, for its cancer-producing activity, this virus is dependent upon stimulation by estrogens, such as diethylstilbestrol. This virus remains in the tissues and exerts its neoplastic effects long after cessation of administration of estrogens. Absence of detectable estrogen in the tissues of animals treated with or fed such a substance thus offers no assurance of the absence of a cancer hazard in such tissues.

A great body of evidence shows that cancer-inciting chemicals can exert their effects in catalytic quantities, inducing changes in cells which are mediated by unknown substances transmitted from cell to cell long after the original cancer-inciting material ceases to be demonstrable in the tissues[2]. No assurance of the absence of such substances can be offered consumers of tissues from animals treated with or fed a carcinogen, such as diethylstilbestrol.

In human beings, a variety of pathological changes have been found to follow administration of estrogens. In women well past the menopause, the course of breast cancer is slowed by estrogens, but in somewhat younger women it is acclerated[11]. There are claims for primary initiation of cancer in women by estrogens[12], but these have been few in contrast to the great number and diversity of tumors following estrogenic treatment of animals. Now, it has been found from animal experiments that the spacing of doses greatly influences the yield of tumors. Most important, it has been learned from animal work that intermittent administration of very large doses of estrogens is far less effective in inducing tumors than is a continuing exposure to an extremely minute dose. This phenomenon has been repeatedly observed by one of us (R. I.) in experiments conducted over a period of nearly twenty years in the laboratory of Prof. Lipschutz[7]. It is a *continuing* exposure to extremely minute doses that is to be feared from the introduction of estrogens into the food supply.

A prime consideration is the long period of time that elapses between first exposure to a carcinogen, such as diethylstilbestrol, and eventual appearance of a tumor. In animal experiments, exposure is customarily begun early in life and the majority of tumors arise when the animals are old. Experience in the results of administration of estrogens to human beings has been

largely limited to treatment of conditions arising fairly late in life. By comparison, the majority of human beings thus far exposed would complete their life span before passage of sufficient time to observe a carcinogenic effect of estrogens. The introduction of estrogens into the food supply, however, presents the problem of exposure of human beings from birth onward. That human beings are not immune to the cancer-inciting action of estrogens is shown by the fact that there are on record some 17 cases of cancer of the breast in *men* given estrogens, including diethylstilbestrol[13].

Yesterday, figures were presented to this symposium[14], which, according to our understanding, represent the finding of about 1 microgram of diethylstilbestrol per pound in the tissue of a steer given the prescribed amount (10 milligrams) of this drug in feed. One pound of such tissue would thus contain about fourteen times the amount of diethylstilbestrol needed as a daily dose to produce cancer in mice, for, as stated above, 0.07 micrograms of diethylstilbestrol per day sufficed to elicit cancer in 50% of mice. Furthermore, claims for the absence of diethylstilbestrol in tissues have been based on a method whose limit of sensitivity[3] is, according to our calculations, in the range of 1 microgram per 1.1 pounds. This means that a pound of meat, certified as free of diethylstilbestrol, could contain nearly fourteen times the amount of this drug necessary to induce cancer by a daily dose to mice. In the case of market poultry found to contain up to 24 milligrams of diethylstilbestrol per bird[4], one is dealing with an amount roughly equivalent to 342,000 times the daily dose necessary to produce cancer in mice.

It would therefore seem prudent that further careful consideration be given the matter of adding to the cycle of food supply a drug known to initiate or aggravate a serious disease.

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BIOLOGICAL CONTROL 100 YEARS AGO

In a list of animals and birds, living in freedom, but housed on the grounds of Canonville Cottage, near Edinburgh in 1836 occurs this interesting note from The Gardener's Magazine, July, 1836: "Rana arborea L., the tree, or green, frog, is green above and whitish beneath, with a yellow curved line on the side. In elegance and activity it is superior to every other European species. It is a native of the south of Germany and of France; in which country it resides in the woods, and mounts the trees in quest of insects, which it approaches on its belly, in the same manner as a cat approaches a mouse and, at length, seizes it with an elastic and instantaneous spring. It is particularly noisy on the approach of rain. In winter, it takes up its abode in the bottom of ponds or other pieces of water, remaining till the spring in a state of torpor. The noise of this frog, is, by many, considered musical; and it is often kept in houses in Germany, both as a curiosity and as a weather guide. When kept in a house, it is placed in a crystal jar, 6 inches or 8 inches in diameter, and 1 foot or 18 inches high, the bottom of which is covered to the depth of 2 to 3 inches with water. In the jar is placed a small ladder, or a rod of wood, leaning to one side, up which the animal mounts, and remains near the top, when the weather is fine; while, on the approach of rain or thunder, it descends to the bottom, utters a peculiarly shrill cry, and plunges up and down in the water. To prevent it from getting out, and, at the same time, to admit air, the jar is covered with gauze. (We brought a frog of this species from Carlsruhe, in 1828 which remained in a glass jar, covered with gauze at the top, living on flies, till the spring of 1832 when it died.)

Rana Bufo L., the toad, is kept in the frames, pits, and stoves, for destroying ants which the toad devours greedily; and also, for keeping under wood lice and other insects, and slugs and worms. The common frog is encouraged for the same purpose . . .

Erinaceus europaeus L., the European, or common, hedgehog, is found useful in the open garden, for clearing the ground of snails and slugs, and the houses of beetles, cockroaches, etc.

WHICH WAY LIES HOPE?

Quotations from a book of this name by Richard B. Gregg, published by Navajivan Press, Ahmedabad, India, 1952.

Mr. Gregg has been a student of Bio-Dynamics since 1941, when he came to Kimberton Farms Agricultural School, and has practiced it on home gardens since 1948. Many of our readers will know him as the author of our booklet "Companion Plants".

Although a Harvard law man, Mr. Gregg gave up law practice in the mid-twenties to live for 4 years in India and study with Gandhi. This fall he plans to go back there for the 5th time, now to teach for a couple of years in one of the Gandhi Training Centers.

The most widely known of Mr. Gregg's writings is "The Power of Non-Violence," but another book on which he has been working for the last 15 years, is being published this year in India, London and New York. On the borderline between philosophy and religion, the title of the American edition will be "The Self Beyond Yourself".

"WHICH WAY LIES HOPE?" was written for India as a comparative examination of Capitalism, Communism, Socialism and Gandhiji's Program. After a brief outline of the problems and possible solutions, he goes into detail on a number of subjects, which from the point of view of BIO-DYNAMICS can scarcely be over-emphasized or often enough repeated at the present time. The Publishers' Note remarks, "Mr. Gregg is nothing if he is not thorough. But more than that he is entirely fair and honest". So we believe the following direct quotations will be of special interest.

First, as to soil erosion, loss of humus (colloidal organic matter) and leaching of essential minerals from the soil. This danger is but slightly realized by city people or the book-educated classes. In its present degree, speed and wide-spreadness it is relatively new in human history; only about 250 years old. There have, of course, been instances of rapid soil erosion in small areas during the entire history of this planet. But during the last 250 years, we are told by the best soil experts, there has been more erosion of top soil than in all previous history of the world put together. This erosion is operative on a vast scale in China, Africa, Australia, most of the countries around the Mediterranean, North and South America, and in a big way also in India. In the United States, for example, one-third of the arable topsoil of that country has been washed into the sea, and further

erosion is proceeding much faster than existing conservation work can reclaim or stop.

Every empire throughout history has ended in deserts. What is now the Sahara Desert was once the wheat-growing area of the Roman Empire. The present dessicated lands of Mesopotamia, Syria, Palestine and parts of Arabia were the sites of the great empires of Babylonia, Sumeria and Ur. Persia was once a great empire. Now it is mostly desert. Greece, under Alexander, was an empire; now its land is mostly barren. The three empires of modern times, British, French and Dutch, have done much to exhaust and despoil the soils and mineral resources of Asia, Africa and America. In this they have, of course, been much aided by the modern developments in transportation, mould plowshares, farm tractors, finance, commerce, and communications.

During floods in the Missouri River basin in July, 1947, it was estimated that more than 115,000,000 tons of rich topsoil were carried off by the rain. In the United States as a whole erosion now is spoiling 500,000 acres of good land every year. If erosion were to continue at its present rate, by the end of the present century over three-quarters of its fertile soil would be lost. And so the story goes. The dreadful tale is found in great detail in the books listed at the end of this essay. Only the British Isles and Western Europe, because of mild temperatures and even distribution of moderate rains all through the year, have escaped soil erosion.

Not only is soil washed away; its fertility is destroyed by excess cultivation. Humus is oxidized and burned up by hot sunshine and essential soluble minerals are leached away.

Although great efforts for soil and forest conservation are being made in the U. S., U. S. S. R., Palestine, South Africa and elsewhere, nowhere have the conservation efforts been able to catch up with the steady erosion. Building dams helps only temporarily, for the reservoirs so created fill up with silt in about 35 years.

The destruction of forests by fires and by the inroads of industrialism for timber, of course, causes fearful floods and more soil erosion. The exploitation is appalling. Only one Sunday edition of the New York Times, for example, requires ten acres of big trees to supply the necessary wood pulp for its paper. There are many other newspapers of equal size in the United States and 52 Sundays in every year, to say nothing of the week days and all the other uses of paper.

In a publication of the United States Soil Conservation Service called "Conquest of the Land through 7,000 Years", the author, W. C. Lowdermilk, says, "If civilization is to avoid a long decline such as has blighted North Africa and the Near East for thirteen centuries and for centuries yet to come, society must be born again out of an economy of exploitation into an economy of conservation."

Along with this steady and rapid shrinkage of food supplies (for that is the result of soil erosion), we now have a rapid increase in world population. This also has been greatly accelerated during the past 250 years. For the first time in the history of the world there are more people in the world than can possibly be fed from the existing land capable of raising food, even with no obstacles of transportation, tariff laws or finance. This is the considered opinion of the Food and Agriculture Organization of the United Nations, after consulting the best authorities of the world in regard to agriculture and population. This is also the opinion of many individual authorities on population and agriculture. Let me give some of the details.

Fairfield Osborn in his book, "Our Plundered Planet", gives an estimate of not over 4,000 million acres of arable land in the whole world. The Food and Agriculture Organization in their monthly bulletin for January 1950 estimated the total land area of the world as 33,126 million acres and the arable land as 3,007 million acres. Pearson and Hayes, of Cornell University, in their book called "The World's Hunger", estimate the total land area as 35,700 million acres. They further estimate that only 43 per cent of this total has adequate rainfall for growing crops, as much as 15 inches of rain a year, which is a low standard of adequacy. Only 34 per cent of the total has rain that is both adequate and reliable. Only 32 per cent, they believe, has enough rain, reliable rain and enough heat, to grow crops. Only 21 per cent has enough rain, reliable rain, enough warmth and is not on too steep a slope to permit cultivation. Lastly, only 7 per cent has enough rain that can be depended upon, enough warmth, is near enough level, and has fertile soil. Seven per cent of 35,700 million acres is 2,499 million acres of arable land. So in all the world there are between 2,500 and 3,007 million acres of land capable of raising food for man. Man cannot change the climate or geography. It is the considered opinion of the experts that very little more land can by any means be brought under cultivation, and that, as a whole, the possible increases in productiveness will not equal the probable increases

in world population, either absolutely or in rate of increase. Since 10 to 15 per cent of arable land is used for fibre crops, tobacco, etc., the total available for food is really less than the above figures indicate.

The total population of the world in 1950 is estimated by the F. A. O., whose figures as to land area were above-cited, as 2,352 million. There seems to be general agreement that this total is between 2,250 million and 2,352 million people.

Dividing the largest figure of estimated total arable land in the world by the smallest estimate of total world population we get about 1.8 acres of land per person in the world. Using the foregoing figures which seem more authoritative, we get a little less than 1.3 acres of land per capita. Call it 1½ acres per head. The generally accepted computation is that 2½ acres of land are required to provide a minimum adequate diet for each person, by Western standards anyhow. On a vegetarian diet it has been estimated that 1½ acres per head may provide enough. The reason for this difference is that animals grazed for meat-eating purposes require about 15 times more land than is necessary to raise an adequate amount of nutrition in the form of grains, vegetables and fruits for human consumption. This means that India, on a vegetarian diet, is living far more wisely within its own land resources than are the meat-eating peoples.

As is well known, different countries have different densities of population; and some have economic and political power which enable them to draw food from other parts of the world more effectively than can some other nations. Hence, some nations are much better fed than others. But the foregoing figures show that even if all the land were evenly and fairly distributed among all the people of the world, and if commerce were completely ideal, and there were no price restrictions or transportation expenses for the movement of foods, and if all the world were vegetarian,—still the people of the world would all be on the edge of malnutrition.

The United Nations F. A. O. states that in spite of local surpluses of food in the Americas, on a world-wide basis the per capita food ration today is less than it was in 1940.

Not only has the population of the world greatly increased during the past 250 years, the growth has accelerated for the past 300 years and population continues to increase. Every day all over the globe there are 68,000 more people born. The current net increase for the world as a whole is about 1 per cent per year . . . Even if the acceleration were to stop . . . and the

present rate were to continue, the total world population would be more than doubled in seventy-five years . . . But the food production of the world is very unlikely to double.

In theory some relief might be obtained by emigration, a more even distribution of population in relation to land resources. Emigration plus birth control will afford relief to a particular country, as shown in the case of Ireland since 1845. But emigration with a continuing high birth rate affords no relief, as shown by the experience of Italy. Between 1880 and 1920 four and a half million people emigrated from Italy to the United States and twelve million more to other countries. Yet, because the birth rate remained high, the population of Italy grew, in that same period, from 29 million to 39 million. From Sicily there was the heaviest emigration, yet it gained in population during those years nearly twice as fast as the rest of Italy. During the years of greatest emigration the population of Italy increased faster than it did before or since then.

All that needs to be made clear now is that the relation between population and food supply faces not only India, but the world as a whole. Because this situation has never before existed for the world as a whole, and because its implications are so grim, people are very reluctant to recognize it and admit it. We dislike unpleasant facts; we are reluctant to think; we hate to change our ways. But Nature and death and birth are more powerful than human inertia . . .

Take the matter of water—that essential of all life. The following information is from "Water or Your Life" by Arthur H. Carhart.

Every gallon of gasoline takes 7 to 10 gallons of water in its manufacture. One ton of viscose rayon demands 200,000 gallons of water in its process of making. To produce a ton of synthetic rubber takes three times that amount. Each ton of paper made in modern paper pulp mills requires 50,000 gallons of water in the making. At the beginning of World War II there were about 200 paper mills in the United States, making about 10,000,000 tons or more of finished paper. That means 500,000,000,000 gallons of water. When it comes to the mills, a ton of cotton cloth requires 60,000 gallons of water in the bleaching and 80,000 gallons in the dyeing process. The manufacture of one pound of refined white sugar calls for 7 gallons of water. 160 gallons of water are needed to make a pound of aluminum. A ton of soap needs 500 gallons of water to make it. When an

airplane engine is tested, the cooling of it requires from 50,000 to 125,000 gallons of water.

Steel, of course, is a necessary ingredient of all machinery, tools, large bridges and railroads. It can be made without much water in the process. But by modern methods, 65,000 gallons of fairly pure water are required to process a single ton of steel in its highly finished form. One of the major uses of water in a modern steel smelter is to cool the big retorts and their doors in order that they may endure the enormous heat of the molten steel and fuel, and so that the employees can work near the furnaces. For such cooling a 150 ton furnace requires nearly 2,800,000 gallons of water a day. Sheet steel mills also use much water for the cleaning of the sheets. Recently the Bethlehem Steel Corporation at Sparrows Point, Maryland, was pumping 15,000 gallons of ground water per minute for its manufacturing uses. Of course not all this water is too polluted in these processes to make it a total loss, but most of it becomes unfit for human drinking or washing purposes, or indeed for agriculture. In 1950 there were about 700 steam-electric plants in the United States, with a total capacity of 40,250,000 kilowatt hours. These plants altogether required 44,883,000 gallons of water *per minute*. That is a lot of water. It is not all consumed, for much of it is used over and over. Yet the figures make one pause for thought.

Streams are polluted and poisoned by city sewage, by coal mining, oil fields, food processing, paper pulp mills, steel plants, all textile industries and chemical industries. This pollution kills all fish in the streams and makes the water unfit and dangerous for any domestic or agricultural use.

Industrialism makes big cities. Every person requires 6 to 8 pints of water per day to keep alive. The bigger the city, the more industries it contains, the greater is its daily per capita use of water. In the United States, a big industrial city uses from 125 to 300 gallons of water per capita per day.

Almost all this use of water means taking it away from agriculture. And in a country like India whose rainfall is irregular in amount from year to year and is crowded into only 3 or 4 months per year, whose population is pressing so desperately on the land for food, it would seem to be a dangerous thing to go in very heavily for industrialism . . .

The City of Los Angeles . . . has pumped up so much ground water for its uses that the land surface thereabouts has sunk as much as 8 feet in some spots. At Long Beach, California, pump-

ing up ground water has pulled down its subsurface level of water 75 feet below sea level; and well water has begun to get salty all along that part of the sea-coast. In the Santa Clara Valley in California in 1910 there were a thousand flowing artesian wells used mostly for agriculture, in addition to more shallow pumping wells. Pumping water expanded from 25,000 acre-feet in 1915 to 134,000 in 1933. The level of below-ground water fell about 5 feet per year until 1933 when it dropped 21 feet. The Valley ground itself sank 5 feet in 20 years, causing millions of dollars of damage to buildings, streets, pipelines and orchards. At Texas City, so much water was needed for industry that many tube wells were sunk, some going down as far as 1,100 feet. In 1939 these wells were supplying about 10,000,000 gallons of water per day, by pumping. World War II increased the demands of industry so much that in 1945 these wells were supplying 22,500,000 gallons per day. As a consequence the water in one tube well there dropped 102 feet below sea level; another well sucked out so much ground water that its level was 165 feet below sea level. As a result the ground water became salty from infiltration of sea water. Also in that area the level of the surface of the ground itself dropped on an average as much as 2.4 inches per year; in some spots the total drop amounted to 1.5 feet. At other places, such as Louisville, Kentucky, far away from the sea, and where the war made great demands on industry, the tube wells began to go dry. Water was being sucked out of the ground faster than it came into the ground.

In California, water pumped out of the ground for irrigation purposes has in many places lowered the level of ground water several hundred feet, and the cost of pumping has begun to get prohibitive . . .

People have got intoxicated with the heady wine of industrialism and hence overlook the meaning of recent events and the march of change. The prosperity they have been enjoying is superficial, is shrinking, and can endure at all but a little while longer.

Industrial nations make machines, tools, conveniences and luxuries and sell them to other nations in exchange for food,—cereals, meat and fruits. England began this policy; Europe and America followed. Japan later did likewise. Having done so, the population in all these countries rapidly and greatly increased. They became very prosperous. But the prosperity was

only as reliable as the outside food supply, and the amount of food purchased in other countries was and still is out of the control of the food-importing countries. As long as there was surplus food anywhere in the world,—Canada, the U. S. A., the Argentine, Australia, Siam, Burma, etc.—it could be drawn into the more advanced industrialized countries. The people with surplus food were glad to sell it in order to get the products of the machines in places like Great Britain and Europe.

But now there is a new situation in the world. Population has increased mightily not only in Britain and Europe but in every land. And the amount of land capable of producing food has increased very little. True, there have been big irrigation projects, tractors, chemical fertilizers, improved seeds. But the increase in food production has not been anywhere near as great as the increases in population. Also, to offset the improvements there has been appalling loss of land everywhere by erosion.

The result is that food-producing areas are exporting less and less. The United States used to export beef, but does no longer. Instead, she is importing beef from the Argentine. The United States and Canada together have been the source of about 75 per cent of the total grain shipments of the world, considerably more coming from the United States. But their lands are eroding, their populations are increasing and the United States, at any rate, will steadily export less and less wheat. Food exports from the United States declined rapidly from 1900 to 1912 and thereafter that nation began to import more food than it exported. The "Agricultural Statistics of the U. S. Department of Agriculture for 1950" states that from 1929 to 1941 inclusive, the value of total agricultural imports into the United States has exceeded that of its total agricultural exports. Beginning with 1942 and running through 1948, that is, during the second World War and after, the exports exceeded the imports in value. But beginning with 1945 the value of agricultural imports has steadily increased, and will probably soon again exceed that of the food exports. The direction of this movement is also shown by the index numbers of *quantities* of wheat exported from the United States from 1929 to 1948 inclusive. Taking the average of wheat exports during the period from 1924 to 1929 as 100, the subsequent exports up to 1945, were all less than 100, ranging erratically from 83 to 8, being 31 in 1944. Then the demands for food from abroad, favorable weather, and high prices of wheat during the war pushed up the U. S. wheat production and

exports. In 1945 the index number was 175; in 1946: 201; 1947: 266; 1948: 278. That is the latest date for which these figures were published. The same publication shows that in regard to wheat alone during this period from 1929 to 1948, there were four years, 1934, 1935, 1936 and 1943, in which more wheat was imported into the United States than was exported from it.

The United Nations Bulletin for March 15, 1949 stated that world production of rice during 1948-49 was 2 per cent below the pre-war average. Yet shipments of rice from the rice-producing countries then was *less than 50 per cent* of the average annual quantity exported before the war. The population of rice-eating areas increased by nearly one hundred million in the 1939-49 decade. Very clearly when food becomes scarce, it is kept where it is raised.

As between industrial products and food, everyone in a pinch must have food. When population is dense and food hard to get, people hold on to their food. As another instance, Asia produces about 40 per cent of the world's total food, but exports only about 2 per cent of what food it produces.

This puts Great Britain and Western Europe into the same dilemma that India faces: too many mouths for the local land to feed. Right now, if it were not for United States money and food subsidies, Western Europe, Great Britain and Japan would be suffering severe famines and millions of deaths from them. Japan is now receiving over a million dollars a day in subsidies from the United States. With the best will in the world, the United States cannot continue this long, for her own soil is eroding and her own population steadily increasing. Between 1900 and 1950 her population has doubled, from 76 million to over 150 million . . .

Agricultural statistics show that under hand labor, as more and more people work the land, the production per man increases up to the density of 4 men per 100 acres or 25 acres per man, and thereafter decreases. But as the number of farm workers increases, the total production per 100 acres and average production *per acre* also steadily increases, though by smaller and smaller increments. The data for Chinese intensive agriculture, given in John Lossing Buck's "Land Utilization in China" (University of Chicago Press, 1937) shows that this increase of total production and average production *per acre* continues up to the place where each farmer has 2.6 acres. Any acreages per farmer smaller than that, showed a slight decline at the rate of 1/10 of a bushel per acre for each of these two declines,—

from 2.6 acres to 2.1 acres per farmer, and from 2.1 acres to 1.5 acres per farmer. These are at bare subsistence level.

In a discussion of these data in Elmer Pendell's "Population on the Loose" pages 36 to 66 (Wilfred Funk, Inc. N. Y. 1951) the following points are made.

If, for example, we were to take away about half the peasantry from the land and set them to work in factories, the data show that the *total* food production of all the acres would be only about 68 per cent of what was being produced when the farm holdings were 5.5 acres per man. If the ratio of population to food were such that that 68 per cent would satisfactorily feed both the peasants still on the land and also those moved into the factories, the change would be advantageous, assuming that the factory products could all be sold year after year. But if that 68 per cent of former total food production were *not* enough to go around among both the factory workers and peasants still on the land, then the change would mean starvation for almost everyone concerned.

Up to the limit of 2.6 acres per farmer it can be stated that under conditions of Chinese intensive farming, anyhow, fewer workers produce a smaller total of food than many workers. In any country with dense population the land must be worked intensively, even far down the scale of diminishing returns, in order to provide enough total food for the entire population. Of course when a farm is less than 4 or 5 acres the population is inefficient, but the total production nevertheless continues to increase until the average per man is less than 2.6. But even when the holdings grow smaller than 2.6 acres per farmer, according to the Chinese figures, the decrease in yield per acre and hence in total yield is less than the drop in production per man. Hence the peasant sticks to the land. Removing people from farms to factories, under present conditions of world trade and population, does not increase the total amount of food in such a country. Increasingly, India, like all other countries, will have to rely on her own production of food.

In such a situation the natural question would be, why not use tractors and chemical fertilizers, and thus increase the crop production enormously, as America seems to have done? There are several objections to that. First, it is uneconomical to use tractors on tiny plots of land. They are so expensive that no peasant or group of peasants could buy one. Chemical fertilizers undoubtedly stimulate the soil, but the stimulus fairly soon decreases; more and more has to be applied per acre each year to

get the same result; the soil organisms decrease; plant diseases increase; insect pests increase; quality of yield goes down; farm expenses rise. Steel mould-board plows which turn over the soil expose too much of the land to the hot tropical sun, thus killing too many of the soil bacteria and other microscopic life on which the life and health of the vegetation depends. It is no mere coincidence that soil erosion in America has advanced with the increase of technology in farming. Methods that are continuously effective in temperate climates with moderate precipitation distributed evenly through the year are dangerous if applied to lands with monsoon rainfall. Even European methods applied indiscriminately to American conditions did much injury to the soil.

If, following the Communist example, the collectivization of farms were attempted in order to make economic the use of big farm machinery, the necessary violence, dislocation of social and economic life would, I believe, destroy the culture and civilization of India, and put nothing viable in its place. It would be better to have vast famines than that, as the history of both China and India shows. That is to say, the cultures of these two countries survived despite former great famines . . .

The densely populated countries, in order to have enough food to live on, *must* maintain a village economy, *must* base their whole economy not on industrialism but on agriculture. Less and less, as world population mounts and world soil erosion continues, will the densely populated countries be able to get food from other countries by way of purchase or even gift. The other countries are not going to have any surplus to part with.

This is a grim fact which the industrialists and landlords and government officials of India must face. They must make conditions which will produce the highest possible continuous, enduring production of food. The aim must not be for highest possible production per agricultural worker, but highest possible production per acre. That is what gives the largest total yield.

The farm land must be owned by the peasants. Only so will it be properly cared for and developed. This is shown by agricultural data from all over the world. Farm tenancy reduces output. It is not just a matter of social justice to the peasants. It is a matter of getting the highest possible amount of food for India; one of the necessary means of preventing worse famines than India has ever had . . .

To say that man cannot go back is to deny that some 21 civilizations studied by the historian Toynbee did go to pieces.

Did not Rome and its technology go back? Did not the Egyptian Empire and its technology disintegrate? In our own time are we not seeing the British and Dutch Empires go back, and the French Empire wobbling? Change can go in all directions. Not all change is progress. Knowledge cannot only be accumulated; it can be and has been lost. Wisdom also can decrease as well as increase.

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